

W91321-04-C-0023

LOGANEnergy Corp.

March AFB PEM Demonstration Project

Proton Exchange Membrane (PEM) Fuel Cell Demonstration
Of Domestically Produced PEM Fuel Cells in Military Facilities

US Army Corps of Engineers
Engineer Research and Development Center
Construction Engineering Research Laboratory
Broad Agency Announcement CERL-BAA-FY03

March Air Force Base, CA Airman's Barracks

10 June 2004

Executive Summary

Under terms of its Fy'03 DOD PEM Demonstration Contract with ERDC/CERL, LOGANEnergy will install and operate a Plug Power GenSys 5kWe Combined Heat and Power fuel cell power plant at March AFB. The unit will be sited at a very visible location at the front of Kisling Hall, building 400, an airman's dormitory. It will be electrically configured to provide grid parallel/grid independent service and also thermally integrated with the facility's hot water system. Local electrical and mechanical contractors will be hired to provide services as needed to support the installation tasks. It is anticipated that the project will add \$36.00 in annual energy costs to March ARB during the period of performance.

The March ARB POC for this project is Jeff Fong whose coordinates are:

jeff.fong@march.af.mil, Phone 909-655-2115

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Proposal – Proton Exchange Membrane (PEM) Fuel Cell Demonstration of Domestically Produced Residential PEM Fuel Cells in Military Facilities

1.0 Descriptive Title

LOGANEnergy Corp. Small Scale PEM 2004 Demonstration Project at March AFB, CA

2.0 Name, Address and Related Company Information

LOGANEnergy Corporation

1080 Holcomb Bridge Road
BLDG 100- 175
Roswell, GA 30076
(770) 650- 6388

DUNS 01-562-6211
CAGE Code 09QC3
TIN 58-2292769

LOGANEnergy Corporation is a private Fuel Cell Energy Services company founded in 1994. LOGAN specializes in planning, developing, and maintaining fuel cell projects. In addition, the company works closely with manufacturers to implement their product commercialization strategies. Over the past decade, LOGAN has analyzed hundreds of fuel cell applications. The company has acquired technical skills and expertise by designing, installing and operating over 30 commercial and small-scale fuel cell projects totaling over 7 megawatts of power. These services have been provided to the Department of Defense, fuel cell manufacturers, utilities, and other commercial customers. Presently, LOGAN supports 30 PAFC and PEM fuel cell projects at 21 locations in 12 states, and has agreements to install 22 new projects in the US and the UK over the next 18 months.

3.0 Production Capability of the Manufacturer

Plug Power manufactures a line of PEM fuel cell products at its production facility in Latham, NY. The facility produces three lines of PEM products including the 5kW GenSys5C natural gas unit, the GenSys5P LP Gas unit, and the GenCor 5kW standby power system. The current facility has the capability of manufacturing 10,000 units annually. Plug will support this project by providing remote monitoring, telephonic field support, overnight parts supply, and customer support. These services are intended to enhance the reliability and performance of the unit and achieve the highest possible customer satisfaction. Scott Wilshire is the Plug Power point of contact for this project. His phone number is 518.782.7700 ex1338, and his email address is scott_wilshire@plugpower.com.

4.0 Principal Investigator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	860.210.8050
Fax	770.650.7317	770.650.7317
Email	samlogan@loganenergy.com	kspitznagel@loganenergy.com

5.0 Authorized Negotiator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	860.210.8050
Fax	770.650.7317	770.650.7317
Email	samlogan@loganenergy.com	kspitznagel@loganenergy.com

6.0 Past Relevant Performance Information

a) Contract: PC25 Fuel Cell Service and Maintenance Contract #X1237022

Merck & Company
Ms. Stephanie Chapman
Merck & Company
Bldg 53 Northside
Linden Ave. Gate
Linden, NJ 07036
(732) 594-1686

Contract: Four-year PC25 PM Services Maintenance Agreement.

In November 2002 Merck & Company issued a four-year contract to LOGAN to provide fuel cell service, maintenance and operational support for one PC25C fuel cell installed at their Rahway, NJ plant. During the contract period the power plant has operated at 94% availability. LOGAN performs the quarterly and annual service prescribed by the UTC, and performs other maintenance as required. The periods of unavailability are chiefly due to persistent inverter problems that seem to be endemic to the Toshiba power conditioning balance of the system. Field modifications and operating adjustments have largely cured the problem. Quarterly service events take 10 hours to complete with the unit under load, and the annual event takes approximately 35 hours with the unit shut down.

- b) Contract: Plug Power Service and Maintenance Agreement to support one 5kWe GenSys 5C and one 5kWe GenSys 5P PEM power plant at NAS Patuxant River, MD. .

Plug Power
Mr. Scott Wilshire.
968 Albany Shaker Rd.
Latham, NY 12110
(518) 782-7700 ex 1338

LOGAN performed the start-up of both units after Southern Maryland Electric Cooperative completed most of the installation work. The units are located at residential sites at Patuxant River Naval Air Station, VA and operate in standard grid connected/grid independent configurations. Both operate at 4.5kWe and have maintained 98% availability. The units, S/Ns 241 and 242 are two of the very latest GenSys models to reach the field. S/N 242 is Plug Power's first LPG fueled system to go into the field. Both have set a new level of performance expectations for this product, and are indicative of the success of the various test and evaluation programs that have been conducted over the past two years.

- c) Contract: A Partners LLC Commercial Fuel Cell Project Design, Installation and 5-year service and maintenance agreement.
Contract # A Partners LLC, 12/31/01

Mr. Ron Allison
A Partner LLC
1171 Fulton Mall
Fresno, CA 93721
(559) 233-3262

On April 20, 2004 LOGAN completed the installation of a 600kWe PC25C CHP fuel cell installation in Fresno, CA. The system operating configurations allow for both grid parallel and grid independent energy service. The grid independent system is integrated with a multi unit load sharing electronics package and static switch, which initial development was funded by ERDC CERL in 1999. This is the third fuel cell installation that uses the MULS System. The thermal recovery package in the project includes a 100-ton chiller that captures 210 degree F waste heat supplied by the three fuel cells to cool the first three floors of the host facility. The fuel cells also provide low-grade waste heat at 140 degrees F that furnishes thermal energy to 98 water source heat pumps located throughout the 12-story building during the winter months.

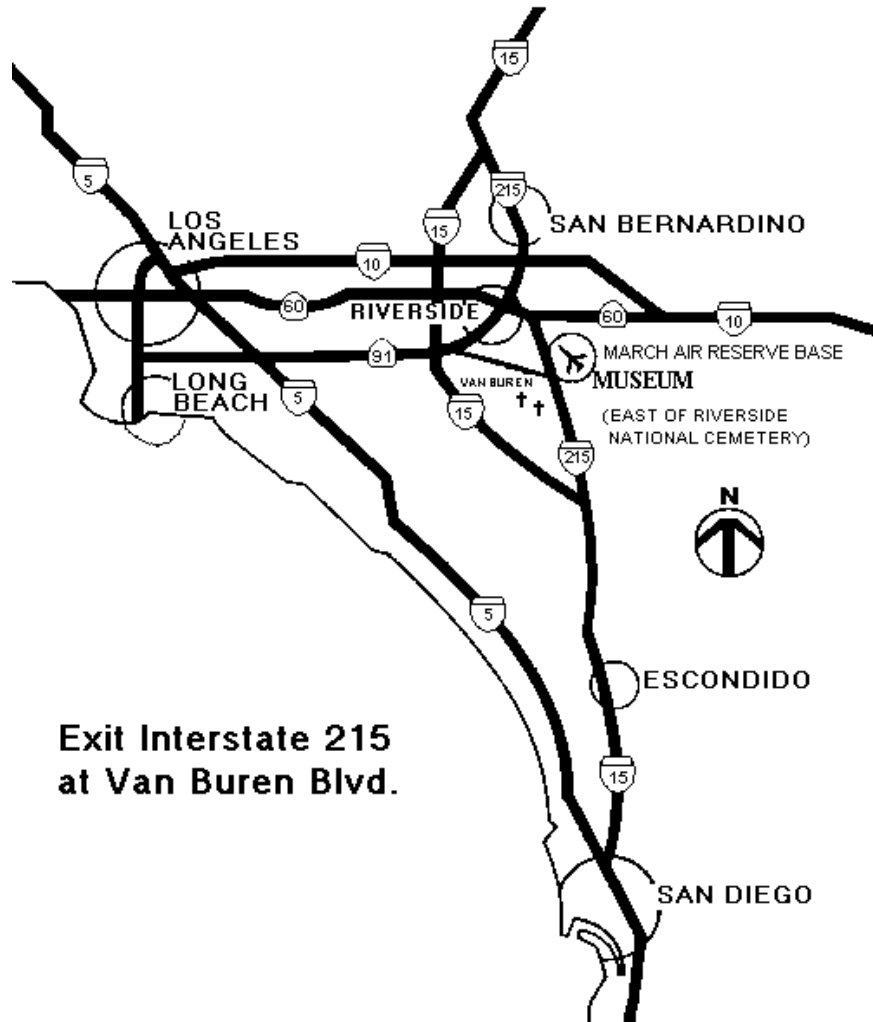
7.0 Host Facility Information

March Air Reserve Base is named for 2nd Lt. Peyton C. March, killed in action on Feb. 18, 1918. It is located 9 mi. southeast of Riverside, California. The base covers about 6,700 acres. Of these 6,700 acres, the Air Force Reserves retain 2,258 acres at the airport. The airfield's 13,300-foot runway is the longest in California

The 4th Air Force, part of Air Force Reserve Command, is headquartered at March ARB. Air Force Reserve Command provides trained units and individuals to accomplish assigned taskings in support of national objectives, and performs peacetime missions that are compatible with training and mobilization readiness requirements. Responsibilities include airlift and refueling

duties. It also provides functional mission support units, including aerial port operations, civil engineer, security forces, intelligence, military training, communications, mobility support, combat logistics support, transportation and services.

The 452nd Air Mobility Wing of the 4th Air Force represents the only unit-equipped mobility wing in the Reserve. The Wing's KC-135 Stratotankers and C-141 Starlifters enable it to effectively perform a worldwide mission 365 days a year. It is the only air mobility wing in the Air Force Reserve Command that possesses all of the elements of an air mobility wing. The 163d Air Refueling Wing (ANG) is a tenant unit at March Air Reserve Base assigned to the Air Mobility Command and the California Air National Guard.



8.0 Fuel Cell Site Information

The photo at right is a picture of Kisling Hall airman's dormitory, Building 400, at March ARB. After conducting two preliminary site visits, LOGAN and the base POC reached consensus that the dorm site would provide the best opportunity to display the fuel cell and install it to best effect. The fuel cell, itself, will be placed on a pad just to the left of the chiller seen in the photo at right.

Building 400 is the preferred site for this project because it has the most accommodating energy use profile of any facility at March, and it has two convenient 350-gallon thermal storage tanks in the mechanical room. All utility connections are within 50 to 60 feet of the pad site. The building does not currently have high speed Ethernet service, but the POC has offered assistance to acquire the service. The site will simulate a critical load application by wiring outside lighting to the fuel cell's emergency load panel.



9.0 Electrical System

The Plug Power GenSys 5C PEM fuel cell power plant provides both grid parallel and grid independent operating configurations for site power management. This capability is an important milestone in the development of the Gensys5 product commercialization schedule. The unit has a power output of 110/120 VAC at 60 Hz, and when necessary the voltage can be adjusted to 208vac or 220vac depending upon actual site conditions. The photo at right shows the electrical service panel in the basement of Building 400 where the fuel cell will be electrically coupled to the base utility grid.



10.0 Thermal Recovery System



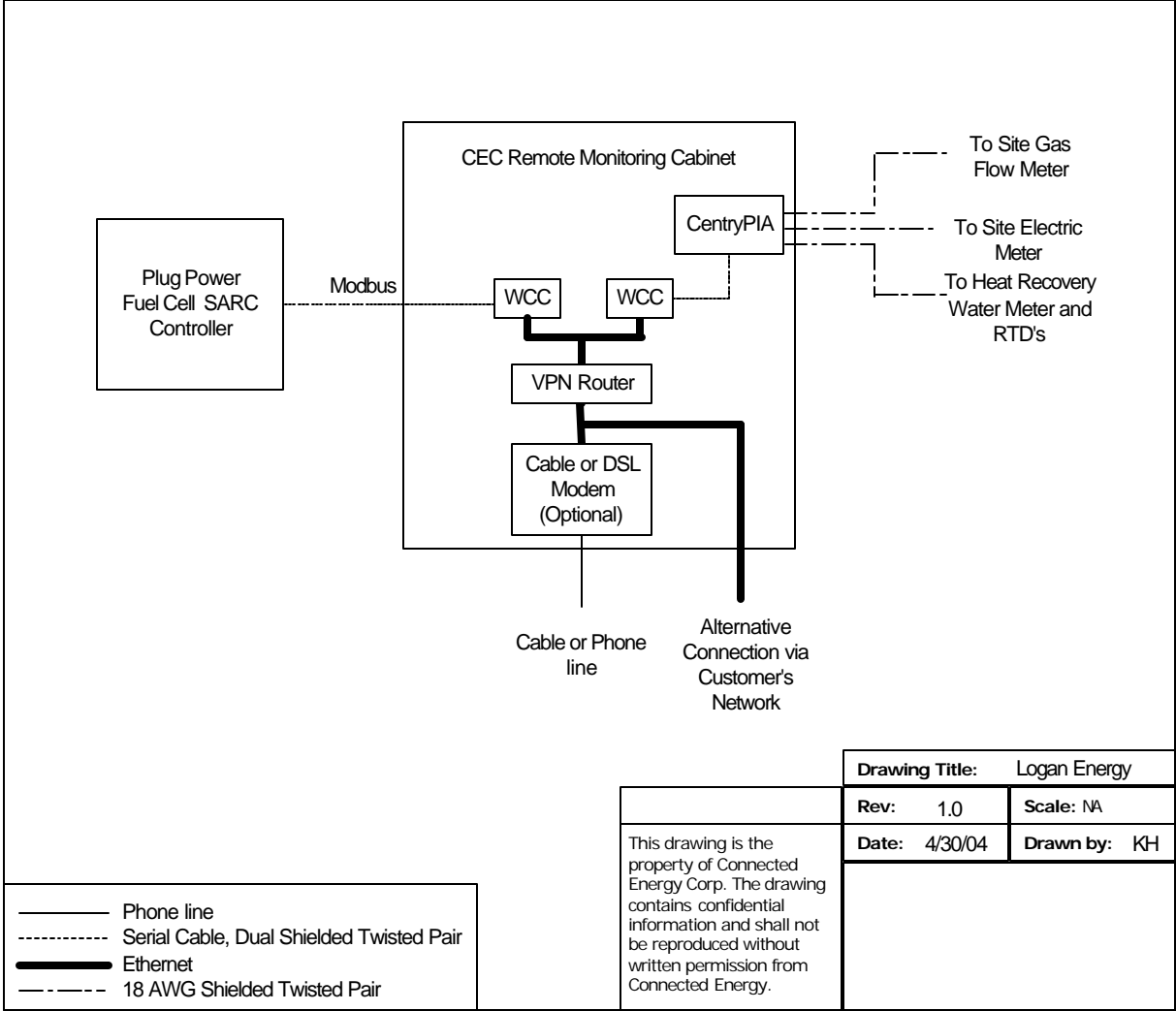
LOGAN intends to employ a Heliodyne heat exchanger to capture fuel cell waste heat and transfer it into the facility's thermal storage tanks, pictured in the photo at left. The Heliodyne is a looped coil within a coil design that provides double wall protection between the heat source and the heat sink. It was designed primarily for the solar heating industry, but has proved to be very adaptable to the fuel cell industry as well. The Heliodyne will mount either directly to one of the storage tanks or on an adjacent wall. It has its own pump that circulates

the storage tank in a counter flow against incoming hot water provided by the fuel cell's heat exchanger. While operating at a set point of 2.5 kWh, the fuel cell provides 7800 Btuh to the storage tank at approximately 140 degrees F. Later in the project LOGAN hopes to gain the cooperation of the base utility engineer in order to map the thermal recovery system to develop a clear picture of its effectiveness in this application.

11.0 Data Acquisition System

LOGAN proposes to install a Connected Energy Corporation web based SCADA system that provides real time monitoring of the power plant. The schematic drawing seen below describes the architecture of the CEC hardware that will support the project. The system provides a comprehensive data acquisition solution and also incorporates remote control, alarming, notification, and reporting functions. The system will pick up and display a number of fuel cell operating parameters on functional display screens including kWh, cell stack voltage, and water management, as well as external instrumentation inputs including Btus, fuel flow, and thermal loop temperatures. CEC's Operations Control Center in Rochester, New York maintains connectivity by means of a Virtual Private Network that will link the fuel cell to the center.

CEC WEB enabled SCADA terminal hardware.



12.0 Economic Analysis

March AFB, CA

Project Utility Rates

1) Water (per 1,000 gallons)	\$ 3.27
2) Utility (per KWH)	\$ 0.0610
3) Natural Gas (per MCF)	\$ 5.64

First Cost				Estimated	Actual
Plug Power 5 kW SU-1				\$ 65,000.00	\$ 65,000.00
Shipping				\$ 1,000.00	
Installation electrical				\$ 2,860.00	
Installation mechanical & thermal				\$ 4,535.00	
Watt Meter, Instrumentation, Web Package				\$ 10,550.00	
Site Prep, labor materials				\$ 1,575.00	
Technical Supervision/Start-up				\$ 2,000.00	
Total				\$ 87,520.00	
Assume Five Year Simple Payback				\$ 17,504.00	\$ -
Forecast Operating Expenses		Volume		\$/Hr	\$/ Yr
Natural Gas Mcf/ hr @ 2.5kW		0.0330	\$	0.19	\$ 1,467.37
Water Gallons per Year		14,016			\$ 45.83
Total Annual Operating Cost					\$ 1,513.20

Economic Summary

Forecast Annual kWH	19710
Annual Cost of Operating Power Plant	\$ 0.077 kWH
Credit Annual Thermal Recovery Rate	(\$0.014) kWH
Project Net Operating Cost	\$ 0.063 kWH
Displaced Utility cost	\$ 0.061 kWH

Energy Savings (Cost) **(\$0.002) kWH**

Annual Energy Savings (Cost) **(\$36.20)**

13.0 Kickoff Meeting Information

The project kick-off meeting occurred at March ARB at 11:00 pm on June 21, 2004. The attendees were be Dr. Mike Binder, representing CERL, and Sam Logan, George Collard representing LOGANEnergy, and Martin Mamawal, Jeff Fong, Kim Chung, and James Crane representing March ARB.

14.0 Status/Timeline

Please see Appendix 2.

Appendix

1. Sample form used to qualify the fuel cell for initial start and the project acceptance test.

Installation/Acceptance Test Report

Site: March AFB, CA

Installation Check List

TASK	Initials	DATE	TIME (hrs)
Batteries Installed	GC		
Stack Installed	GC		
Stack Coolant Installed	GC		
Air Purged from Stack Coolant	GC		
Radiator Coolant Installed	GC		
Air Purged from Radiator Coolant	GC		
J3 Cable Installed	GC		
J3 Cable Wiring Tested	GC		
Inverter Power Cable Installed	GC		
Inverter Power Polarity Correct	GC		
RS 232 /Modem Cable Installed	GC		
DI Solenoid Cable Installed with Diode	GC		
Natural Gas Pipe Installed	GC		
DI Water / Heat Trace Installed	GC		
Drain Tubing Installed	GC		

Commissioning Check List and Acceptance Test








TASK	Initials	DATE	TIME (hrs)
Controls Powered Up and Communication OK	GC		
SARC Name Correct	GC		
Start-Up Initiated	GC		
Coolant Leak Checked	GC		
Flammable Gas Leak Checked	GC		
Data Logging to Central Computer	GC		
System Run for 8 Hours with No Failures	GC		

March ARB PEM Fuel Cell Demonstration Project

Installation, Monitoring, Performance Evaluations, & Reproting on One Plug Power PEM Fuel Cell At Airman's Dorm, Bldg #400

Column Headings Indicate the Beginning of Each Month

Installation Schedule

Tasks	Jun-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04	Jan-05	Feb-05	Mar-05	Apr-05	May-05	Jun-05	Jul-05	Aug-05	Sep-04	Oct-05
Kick -Off Initial Report																
Mobilization																
Installation																
Start-up																
Acceptance Visit																
Mid Term Report																
Project Deconstruction																
Final Report																

LOGANEnergy:
06/21/04

LOGANEnergy:
09/27/04

LOGANEnergy:
10/1-31/04

LOGANEnergy:
11/01/04

LOGANEnergy:
01/19/05

LOGANEnergy:
01/31/05

LOGANEnergy:
10/31/05

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